ENROLLMENT IN HIGH SCHOOL MATHEMATICS AND SCIENCE IN KANSAS

by

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A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Education

KANSAS STATE UNIVERSITY
OF AGRICULTURE AND APPLIED SCIENCE

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INTRODUCTION

This study of enrollments in mathematics and science subjects in Kansas high school covers the school year 1957-58. The study was made to find the number and percentage of pupils enrolled in the areas of mathematics and science and in the subjects in the mathematics and science areas. Comparison is made with the study done by Shearburn (7) for the school year 1953-54.

A limited study was made on how many units of mathematics and science were taken by Kansas high school seniors who were considered talented in mathematics and science. A comparison was made between these findings and the findings and recommendations made by Conant (3).

SCOPE AND METHOD OF STUDY

The study was made by compiling information from the annual principals' reports for the year 1957-58. The reports cover all Kansas public, private, and parochial high schools that come under the classification of the 8-4 plan of organization. There were 498 Kansas high schools in 1957-58 which were of the 8-4 type of organization.

The high school principals' organization reports listed specific subjects in the areas of mathematics and science. Under mathematics were found the subjects of Algebra I and II, Plane Geometry, Solid Geometry, General Mathematics, Trigonometry, and Business Arithmetic. Under science were General Science, Biology, Physics, Chemistry, Physiology, and Botony. Each subject was treated separately as well as part of a total for all mathematics and science.

In the Kansas study of enrollment in mathematics and science there were nine principals' reports that showed no enrollment for the different subjects offered; therefore, these reports could not be used.

For the study on the number of units of mathematics and science that were taken in high school by pupils talented in those subjects, it was necessary to identify the talented. The criteria for determining those students who were talented in mathematics and science was obtained from Education for the Talented in Mathematics and Science (8). The talented rank at the eightieth percentile or above on each of the following subtests of the Differential Aptitude Test: Verbal Reasoning, Numerical Reasoning, Abstract Reasoning, Spacial Relations, and Mechanical Reasoning.

There were five high schools in Kansas that had Differential Aptitude Test scores for their 1959 seniors. In those high schools a total number of twelve senior students were found to be talented in mathematics and science. Eight of these students were females and four were males. A senior population of 408 was listed from these five schools.

REVIEW OF LITERATURE

The impression has been created that proportionally fewer of today's youths are being instructed in the standard subjects of general education (especially mathematics and science) than was the case fifty years ago.

This is stated as such by Dr. Arthur Bestor (2) in the U. S. News and World Report, November 30, 1956. "Lots of American high schools don't even offer courses in the basic sciences and advanced mathematics, that is, geometry and algebra. And an increasing percentage of American students aren't taking the courses even when offered." Dr. Bestor's article has created many replies.

Walter C. Eells (4) in his article in The School Executive, March 1957, states that in 1900, 436,000 high school students were taking some science course. This number had increased to 3,418,000 in 1956, or almost eight times as many. With mathematics, the increase in number was from 446,000 to 3,482,000----again eight times as many.

M. H. Ahrendt (1) in his article in The Mathematics Teacher, April 1958, gave the enrollments in mathematics and science subjects expressed as the percentage of pupils in the grade where the course is usually offered. The percentages are given for the 1956-57 school year.

About two-thirds of the ninth-grade students studied algebra, 43 per cent of the ninth-grade students studied general mathematics, 42 per cent of the sophomores studied plane geometry, almost one-third of the juniors studied algebra II, nine per cent of the seniors studied trigonometry, and seven and one-half per cent of the seniors studied solid geometry.

About two-thirds of the ninth-grade students studied general science, three-fourths of the sophomores studied biology, 35 per cent of the juniors studied chemistry and almost 25 per cent of the seniors studied physics.

John A. Nietz (6) in his article in School Science and Mathematics, October 1957, showed that proportionately more students took mathematics and science in high school in 1948-49 than in 1899-1900. While the total population in the United States less than doubled in the last half century, the high school enrollment increased more than ten-fold.

Of the number of youth 14-17 years of age twice as many were taking physics; three and one-half times as many, algebra and geometry; five times as many, biology; and eight times as many, chemistry.

Harold C. Hand (5) in his article in the AAUP Bulletin, June 1957, gives the ratio of 1900-1950 percentage increase in enrollment to 1900-1950 percentage increase in the number of all youths of high-school age in the United States. The percentage increase in enrollment in geometry was 10 to 1; chemistry, 25 to 1; and physics, 5 to 1. The number of all youths of high school age in the United States increased 37 percent.

All of the facts cited in the articles were originally published by the U. S. Office of Education. The facts that have been presented are for the United States. However; the controversy is the same whether nationwide or just in Kansas.

FINDINGS

Table 1 shows the number and percentage of pupils enrolled in all mathematics and science subjects in Kansas in 1957-58.

Table 1. Pupil enrollment in all mathematics and science subjects in Kansas in 1957-58.

Subjects	Number of pupils enrolled in subject	Number of pupils in school	Percentage enrolled in subject
Mathematics	31,144	58,072	53.6
Science	28,686	58,072	49.4

Table 2 shows the comparison of the pupil enrollment in mathematics subjects in Kansas for the years 1953-54 and 1957-58.

Table 2. Comparison of the pupil enrollment in mathematics subjects in Kansas for the years 1953-54 and 1957-58.

Year	Number of pupils enrolled in subject	Number of pupils in school	Percentage enrolled in mathematics subjects
1953-54	28,308	56,564	50.1
1957-58	31,144	58,072	53.6

Table 3 shows the comparison of the pupil enrollment in science subjects in Kansas for the years 1953-54 and 1957-58.

Table 3. Comparison of the pupil enrollment in science subjects in Kansas for the years 1953-54 and 1957-58.

Year	Number of pupils enrolled in subject	Number of pupils in school	Percentage enrolled in science subjects
1953-1954	27,629	56,564	48.9
1957-1958	28,686	58,072	49.4

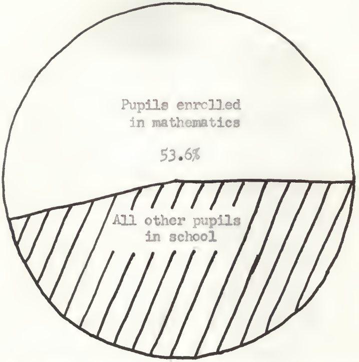

Fig. 1. Ratio of pupil enrollments in mathematics in Kansas high schools in 1957-58 to the total number of pupils in school.

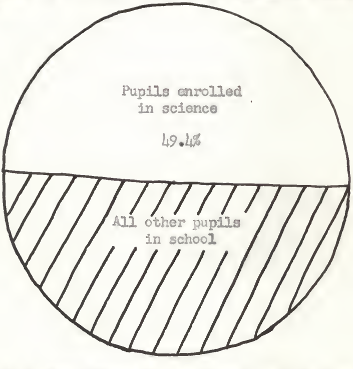

Fig. 2. Ratio of pupil enrollments in science in Kansas high schools in 1957-58 to the total number of pupils in school.

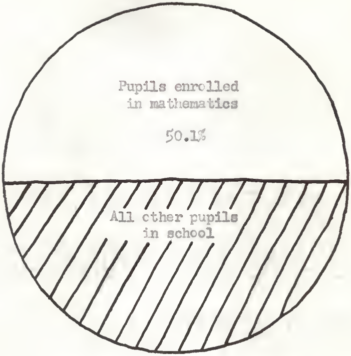

Fig. 3. Ratio of pupil enrollments in mathematics in Kansas high schools in 1953-54 to the total pupil enrollment.

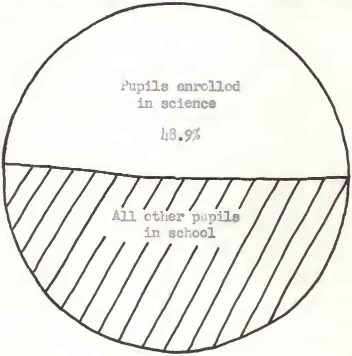

Fig. 4. Ratio of pupil enrollments in science in Kansas high schools in 1953-54 to the total pupil enrollment.

Table 4 shows the number and percentage of enrollment in mathematics subjects in Kansas high schools for 1957-58.

Table 4. Pupil enrollment in mathematics subjects in Kansas high schools for 1957-58.

Subjects	Number of pupils enrolled in subject	Percentage of pupils enrolled in subject
Algebra I	13,613	43.7
Algebra II	2,992	9.6
Plane Geometry	7,526	24.2
Solid Geometry	342	1.1
Trigonometry	538	1.7
General Mathematics	5,280	17.0
Business Arithmetic	853	2.7
Total	31,144	100.0

Table 5 shows the number and percentage of enrollment in science subjects in Kansas high schools for 1957-58.

Table 5. Pupil enrollment in science subjects in Kansas high schools for 1957-58.

Subjects	Number of pupils enrolled in subject	Percentage of pupils enrolled in subject
General Science	9,279	32.4
Biology	12,556	43.7
Physics	2,612	9.1
Chemistry	3,865	13.5
Physiology	295	1.0
Botany	79	.3
Total	28,686	100.0

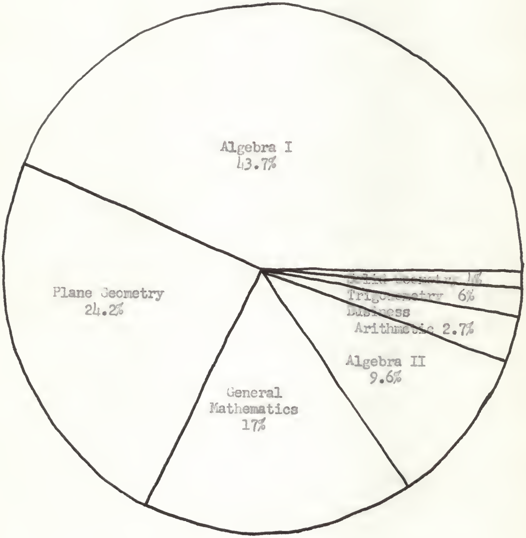

Fig. 5. Analysis of pupil enrollments in mathematics by subjects in Kansas high schools for 1957-58.

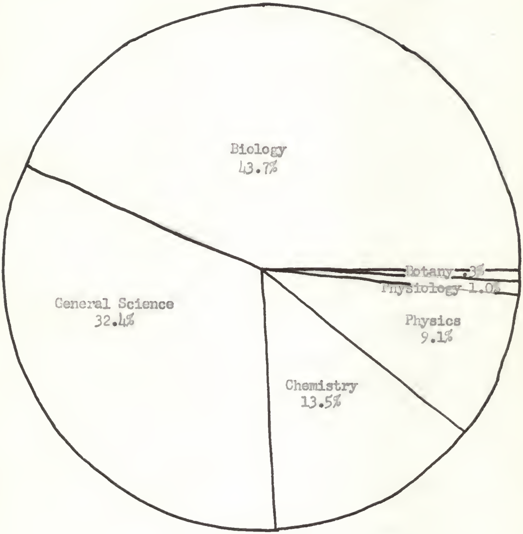

Fig. 6. Analysis of pupil enrollments in science by subjects in Kansas high schools for 1957-58.

COMPARISON OF FINDINGS WITH THE FINDINGS FOR 1953-54

Table 1 shows a greater number of pupils enrolled in mathematics subjects than enrolled in science subjects in 1957-58. Pupil enrollment in mathematics subjects is 4.2 per cent greater than pupil enrollment in science subjects.

Table 2 indicates an increase of 3.5 per cent in enrollment in mathematics subjects from 1953-54 to 1957-58. A slight increase of 0.5 percent in enrollment in science subjects is indicated by Table 3 for the same years. The increase in enrollment in mathematics subjects may indicate a trend towards increased enrollment in mathematics. However, the increase in science subjects does not seem significant to indicate a trend in enrollments in science.

According to Table 4, algebra I had the greatest number and the largest percentage enrolled of any of the mathematics subjects. With 43.7 per cent of the pupils enrolled in algebra I, plane geometry followed with an enrollment of 24.2 per cent of the total number of pupils. The difference in enrollment between algebra I and plane geometry is 19.5 percent. General mathematics followed plane geometry in enrollment with 17 per cent of the total enrollment. Only about 15 per cent of the total enrollment was enrolled in the other mathematics subjects—algebra II, solid geometry, trigonometry, and business arithmetic.

Biology had the greatest number and the largest percentage enrollment of any of the science subjects as shown in Table 5. Biology had 43.7 per cent enrollment and general science with 32.4 per cent enrollment was second, with a difference of 11.3 per cent. Chemistry was the third choice for enrollment in science with 13.5 per cent of the pupils enrolled.

Enrollment in physics, physiology, and botany comprised only slightly over 10 per cent of the total enrollment in science.

Table 6 shows the number of talented senior girls and boys who had enrolled in mathematics subjects in five Kansas high schools and the total units of credit received by them.

Table 6. Enrollment in mathematics by subjects of talented girls and boys in five Kansas high schools and the total units of credit received.

Subject	Number of girls enrolled	Number of boys enrolled	Total number of students in subject	Total units of credit
Algebra I	8	4	12	12
Plane Geometry	7	4	11	11
Algebra II	2	4	6	4
Solid Geometry	2	3	5	2.5
Trigonometry	1	1	2	2
			Total	30.5

Table 7 shows the number of talented senior girls and boys who had enrolled in science subjects in five Kansas high schools and the total units of credit received by them.

Table 7. Enrollment in science by subjects of talented girls and boys in five Kansas high schools and the total units of credit received.

Subject	Number of girls enrolled	Number of boys enrolled	Total number of students in subject	Total units of credit
General Science	1	1	2	2
Biology	7	4	11	11
Physics	3	4	7	7
Chemistry	3	3	6	6
			Total	26

Table 8 presents the number and percentage of talented senior students who had enrolled in mathematics courses in five Kansas high schools.

Table 8. Percentage enrollment in mathematics courses of 12 students talented in mathematics and science in five Kansas high schools.

Subject	Number of students enrolled in subject	Percentage of talented students who had enrolled in subject
Algebra I	12	100
Plane Geometry	11	92
Algebra II	6	50
Solid Geometry	5	42
Trigonometry	2	17

Table 9 shows the number and percentage of talented senior students who had enrolled in science courses in five Kansas high schools.

Table 9. Percentage enrollment in science courses of 12 students talented in mathematics and science in five Kansas high schools.

Subject	Number of students enrolled in subject	Percentage of talented students who had enrolled in subject
Biology	11	92
Physics	7	58
Chemistry	6	50
General Science	2	17

Fig. 7. Percentage of talented senior students who had enrolled in mathematics subjects in five Kansas high schools.

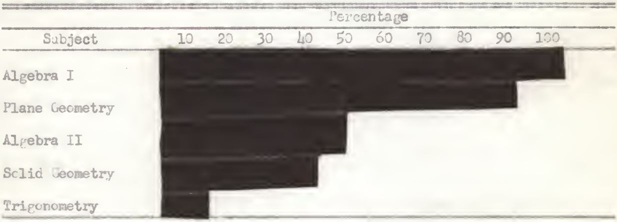

Fig. 8. Percentage of talented senior students who had enrolled in science subjects in five Kansas high schools.

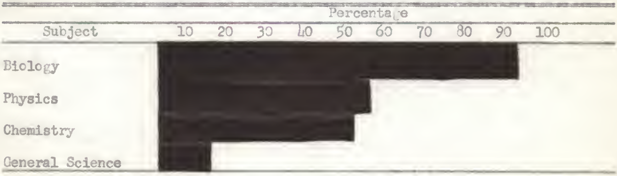

Table 10 shows the number of units of credit received in mathematics and science by high school senior girls talented in mathematics and science.

Table 10. Units of credit in mathematics and science of high school senior girls talented in mathematics and science.

Girls	Units of credit in mathematics	Units of credit in science	Total of mathematics and science units
A	3	3	6
B	2	1	3
C	2	2	4
D	1	1	2
E	2	1	3
F	2	1	3
G	4	3	7
H	2	2	4

Table 11 shows the number of units of credit by years received in mathematics and science by high school senior boys talented in mathematics and science.

Table 11. Units of credit in mathematics and science of high school senior boys talented in mathematics and science.

Boys	Units of credit in mathematics	Units of credit in science	Total of mathematics and science units
A	3	3	6
B	3	4	7
C	4	3	7
D	3	2	5

Table 12 shows the number of talented senior girls and boys by units of credit they received in mathematics.

Table 12. Number of talented senior girls and boys by units of credit in mathematics.

	Units of credit in mathematics			
	1	2	3	4
Girls	1	5	1	1
Boys	0	0	3	1
Total	1	5	4	2

Table 13 shows the number of talented senior girls and boys by units of credit they received in science.

Table 13. Number of talented senior girls and boys by units of credit in science.

	Units of credit in science			
	1	2	3	4
Girls	4	2	2	0
Boys	0	1	2	1
Total	4	3	4	1

Table 14 shows the number of talented senior girls and boys by units of credit they received in mathematics and science.

Table 14. Number of talented senior girls and boys by units of credit in mathematics and science.

	Units of credit in mathematics and science						
	1	2	3	4	5	6	7
Girls	0	1	3	2	0	1	1
Boys	0	0	0	0	1	1	2
Total	0	1	3	2	1	2	3

ENROLLMENTS IN MATHEMATICS AND SCIENCE COURSES OF PUPILS TALENTED IN MATHEMATICS AND SCIENCE

To give interpretation and meaning to the enrollments in mathematics and science courses of pupils talented in mathematics and science in Kansas high schools, a comparison was made with some of the findings made by Conant (3), p. 20 and his recommendations for the talented. Conant referred to the academically talented as the top 15 to 20 per cent of the student body as indicated by aptitude tests of one sort or another, records of their work in the lower grades, and teacher evaluations. The talented in mathematics and science in this study probably would consist of the top one-fourth of Conant's top 20 per cent.

Of the 12 pupils who were considered talented in mathematics and sciences, all of them enrolled in algebra I, as shown in Table 6. Plane geometry was enrolled in by all but one girl. Algebra II was enrolled in by half of the 12 pupils; all of the boys enrolled but only two of the girls enrolled. Three boys and two of the girls had taken solid geometry, making a total of five. Trigonometry was taken by only one girl and one boy.

No science course was selected by all of the 12 pupils talented in mathematics and science. Biology was at the top of the list in enrollment with seven boys and four girls or a total of 11 pupils. Enrollment in physics and chemistry was evenly balanced with three girls in each course, four boys in physics, and three boys in chemistry. General science was taken by only one girl and one boy.

Conant (3) p. 22, 57, has recommended four units of mathematics and three units of science for the academically talented. This would be a total of seven units of mathematics and science. In the eight schools which Conant considered as fulfilling the objectives of a comprehensive high school, he found that more than half of the academically talented boys had studied seven units of mathematics and science. He found that no school had a majority of the academically talented girls who had studied seven units of mathematics and science.

Of the eight girls in this study, Table 12 shows only one girl had taken the recommended four units of mathematics, one girl had three units of mathematics, five girls had two units of mathematics, and one girl had one unit of mathematics. Of the four boys in this study, one boy had the recommended four units of mathematics and three boys had three units of mathematics.

Two of the eight girls in this study had taken the three units of science which is recommended by Conant. Two of the girls had two units of science and four of them had one unit of science as shown in Table 13. One boy had taken four units of science, two boys had taken three units of science, and one boy had taken only two units of science. Only one-fourth of the girls had taken at least the three units of science and three-fourths of the boys had taken at least three units of science.

For the recommended seven units of mathematics and science, Table 14 shows that only one girl had taken seven units. One girl had a total of six units, two had a total of four units, three had a total of three units, and one had only one unit of mathematics and science. Only one-eighth of the girls had the recommended number of units of mathematics and science.

Two of the boys had a total of seven units of mathematics and science, one had a total of six units, and one had a total of five units. One-half of the boys had the recommended seven units of mathematics and science.

SUMMARY AND INTERPRETATION

As shown in the review of the literature on enrollments in mathematics and science, enrollments in these areas have increased tremendously over the past half century. Proportionally, more of American youth enrolled in the areas of mathematics and science in 1959 than in 1900.

The trends in mathematics and science enrollments, which this study was planned to bring out, were rather negligible. Mathematics did show more of an increase in number and percentage of enrollment than did science from the year 1953-54 to 1957-58.

Slightly more than half of the school population were enrolled in mathematics subjects in 1957-58, while just half of the school population were enrolled in mathematics subjects in 1953-54. Of the total school population slightly less than half were enrolled in science subjects for 1953-54 to 1957-58.

In the mathematics subjects algebra I had a much larger percentage of pupil enrollment than the other courses in mathematics. This was due in part to the fact that one year of mathematics was required for graduation from Kansas high schools. Many small schools offered only algebra I and plane geometry for students to fulfill this requirement. Plane geometry ranked second in percentage of total enrollments in mathematics.

Algebra I, plane geometry, and general mathematics account for nearly 85 per cent of the pupil enrollment in mathematics.

Algebra II, solid geometry, trigonometry, and business arithmetic were not offered in most of the small schools. Because of small pupil enrollment in school, a broad curriculum could not be offered.

In the science subjects biology and general science account for over 75 per cent of the pupil enrollment in science. Biology ranked first with 11.3 per cent over general science, which ranked second. One year of science was required for graduation from Kansas high schools. Many schools offered only general science or biology to fulfill this requirement. Most schools with small enrollments could not afford the facilities and equipment for physics and chemistry. Also, they could not afford a second teacher for subjects such as physiology and botany.

For the limited study of enrollments in mathematics and science courses of pupils talented in mathematics and science, the top one-fourth of students who were considered talented by Conant were considered talented in mathematics and science.

Algebra I was selected by all the students talented in mathematics and science. Trigonometry was selected by one girl and one boy. It was usually offered as the twelfth year course in mathematics. Apparently most of the talented chose not to take a mathematics course in their senior year.

There was no science course unanimously selected by the talented students. However, more of the talented students selected the upper level of science courses than selected the upper level of mathematics courses.

Conant recommended a total of seven units of mathematics and science for the academically talented. Of the eight girls in this study found to be talented in mathematics and science, only one girl had taken a total of seven years in the two areas. Only one girl took four years of mathematics and two girls took three years of science. Of the four boys in this study, half of them had taken a total of seven years in the two areas. Only one boy took the recommended four years in mathematics but three of them took at least three years of science. The boys had more units of credit for mathematics and science, proportionally, than did the girls. This is an indication that the girls who are talented in mathematics and science need to be encouraged to elect to take these courses in high school.

ACKNOWLEDGMENT

The writer wishes to express her gratitude and deep appreciation to Dr. H. Leigh Baker, her major instructor, for his generous amount of time, encouragement, constructive criticism, and interest in the preparation of this report.

Indebtedness is also acknowledged to the State Superintendent of Public Instruction and his staff for making available information for this study.

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ENROLLMENT IN HIGH SCHOOL MATHEMATICS AND SCIENCE IN KANSAS

The study was made primarily to find the number and percentages of pupils enrolled in the areas of mathematics and science and in the subjects in the mathematics and science areas in Kansas high schools. It was hoped the report would show trends in enrollments in the different subjects.

The study was made by compiling information from the Kansas annual principals' reports for the year 1957-58. Reports of all schools with an 8-4 plan of organization were used, a total of 498 Kansas high schools.

Literature on whether proportionally fewer of the high school youth of the United States were taking mathematics and science subjects than was the case fifty years ago was reviewed.

Pupil enrollment was greater in the total mathematics area than in the total science area. Algebra I and plane geometry were the top subjects in enrollment in the area of mathematics. In the area of science, biology and general science were at the top of the list in enrollments.

In comparing the pupil enrollment in mathematics for the year of 1953-54 and 1957-58, the percentage enrollment increased slightly for 1957-58. The comparison for the science enrollment showed only a slight increase for 1957-58.

For the study on the enrollment of talented senior students in mathematics and science, the talented in mathematics and science were identified from the criteria given in "Education for the Talented in Mathematics and Science," published by the U. S. Office of Education.

These criteria were percentile standings on the first five subtests of the Differential Aptitude Test.

Seven units of credit in mathematics and science were recommended by Conant for talented students. Of the eight senior girls found to be talented in mathematics and science, only one girl had taken seven units of credit in two areas. Of the four senior boys found to be talented in mathematics and science, two boys had seven units of credit in the two areas. Proportionally, the talented senior boys had taken more mathematics and science than the talented senior girls.